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Channel Characteristics and Large Organic Debris in Adjacent Burned and Unburned Watersheds, Park County, Wyoming

INTRODUCTION

Fire affects not only vegetation communities, but also hydrologic and geomorphic processes. Fire-caused changes in vegetation and soils can impact stream channels through altered hydrology, sediment inputs, and riparian disruption, and produce effects on channel erosion, sediment storage and transport, and large organic debris (LOD). Many fire effects are immediate or short-term, while other impacts are delayed or long-term effects.

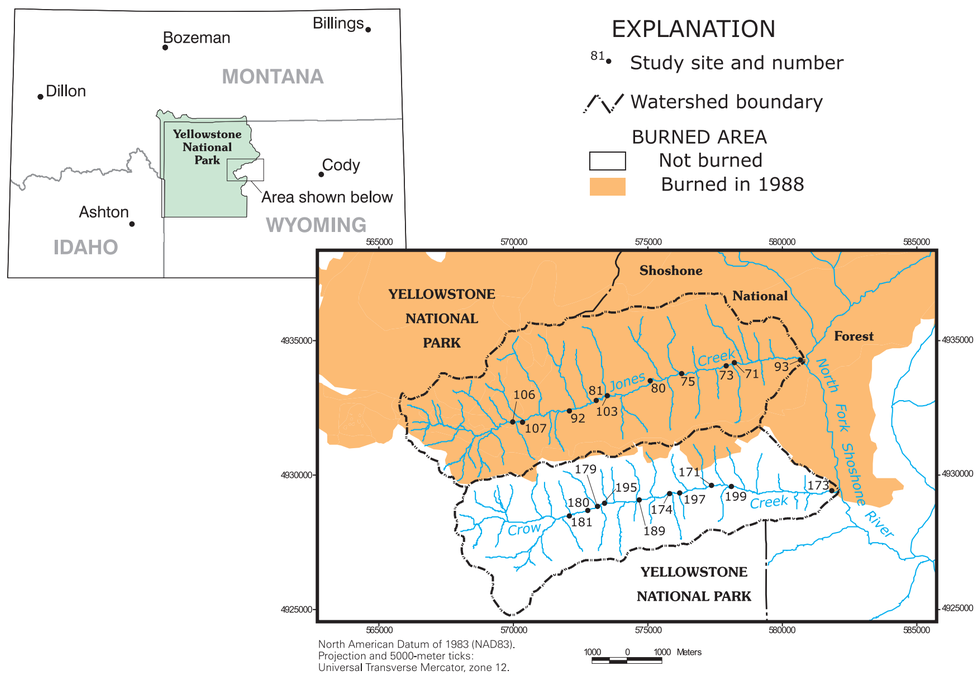

Figure 1. Location of study area, sampling sites, and area burned by 1988 wildfires.

Late in the 1988 wildfire season, the Clover-Mist Fire spread eastward from Yellowstone National Park and burned nearly all of the 6680-ha Jones Creek watershed of the North Fork Shoshone River basin. However, less than 8 percent of the adjacent, 4950-ha watershed of Crow Creek was burned. These two watersheds (fig. 1) are very similar in topographic, geologic, and vegetation characteristics, except for recent fire-disturbance level (figs. 2 and 3) and the modest size difference. During 1998-1999, ten reaches of each stream were studied to quantify differences in width, substrate, residual pool volume and percentage of that volume occupied by fine sediment (V*), and LOD load and characteristics, that may be attributed to wildfire disturbance.

Figure 2. Nearly all forested area within Jones Creek watershed was burned in 1988. A landslide occurred following heavy snowpack in 1996, and delivered large volumes of sediment and organic debris into Jones Creek.

Figure 3. Less than 8 percent of Crow Creek watershed was burned in 1988. Wildfire burned across the ridge separating the two watersheds and burned the area shown here in distance, located north of site 174.

CHANNEL CHARACTERISTICS

A multiple-regression model explained 87 percent of the variability in reach-average bankfull width as a function of drainage area, number of large LOD jams, and a dummy-variable for the difference between streams (fig. 4). Average width of Jones Creek was 6.6 percent greater than that of Crow Creek. Bankfull widths of pools and riffles also were analyzed separately, and for riffles, the difference between streams was smaller: average width for Jones Creek was 5.4 percent greater than that of Crow Creek. A multiple-regression model explained 69 percent of the variability in median particle diameter of substrate on riffles (fig. 5) as a function of reach gradient and the dummy-variable for difference between streams. Average d50 of Jones Creek riffles (58 mm) was 16 mm, or 28 percent, coarser than that of Crow Creek. Increases in channel width and riffle substrate coarseness are consistent with theoretically predicted channel responses to increased runoff following fire.

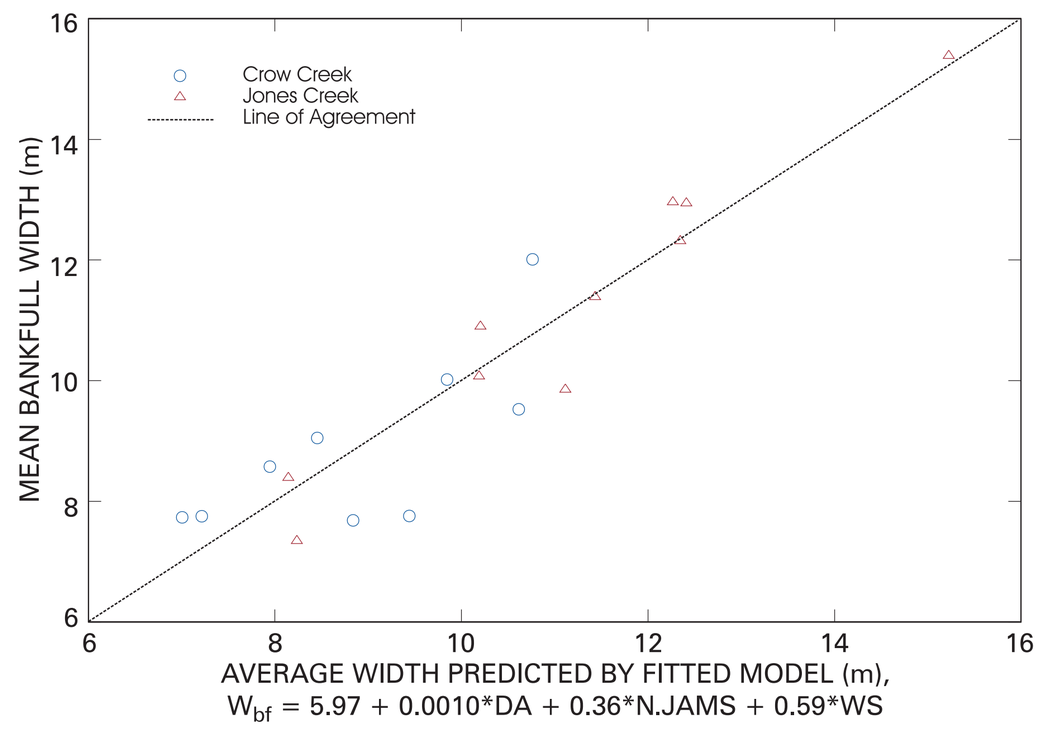

Figure 4. Results from multiple regression model for reach-mean bankfull width indicate that Jones Creek reaches are 0.59 m wider than Crow Creek reaches, after accounting for relations with drainage area, and number of organic-debris jams. The difference between watersheds likely represents the increased runoff following wildfire in Jones Creek watershed.

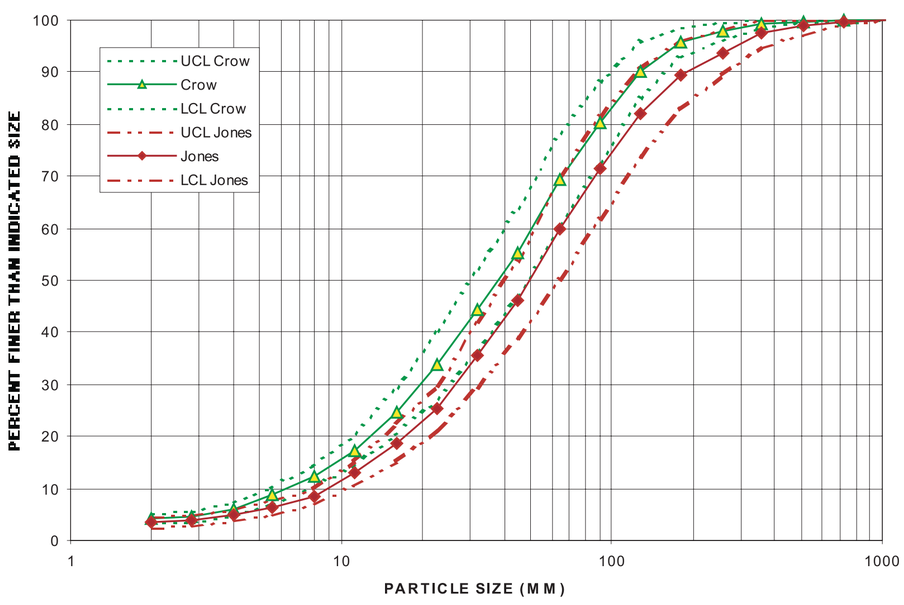

Figure 5. Mean grain-size distributions on riffles of the two study streams, and 90-percent confidence intervals. Although simple comparison between streams shows no significant difference, multiple regression results indicate that median grain size (d50) on Jones Creek riffles is 16 mm coarser (with 3.4 mm standard error) than that for Crow Creek, after accounting for differences in reach gradient.

Residual pool volume (fig. 7) and reach-average V* (V^*_w) did not significantly differ between streams. Median V^*_w was 17 percent for Crow Creek and 23 percent for Jones Creek overall (fig. 6). Results from regression models indicate that for both streams, deeper pools, larger pools, and more closely spaced pools are all associated with greater filling by fine sediment. Multiple regression results for pool-fines size distribution indicate that reach-average gradient explains 64 percent of the variability in median diameter, with no significant difference between the streams.

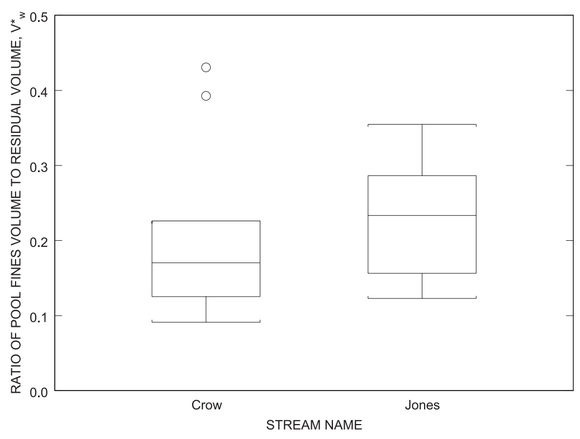

Figure 6. Reach-average fraction of pool volume filled by fine sediment tends to be greater in the burned watershed, but the difference is not statistically significant.